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son Physical Laboratory, Harvard University.

The author has been able to reach the wavelength λ 600, and finds 7 or 8 lines in the helium spectra between λ 900 and λ 600, some of the lines being fairly strong.

14. *Unsymmetrical Lines in Tube-Arc and Spark Spectra as an Evidence of a Displacing Action in these Sources*: A. S. KING, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

The observed effects seem to be harmonized by considering as a necessary condition the presence of electrified particles moving at high velocities, these being produced in the arc and spark by the strong potential-gradients and in the tube-arc by the large consumption of energy.

15. *On the Factorization of Various Types of Expressions*: HENRY BLUMBERG, Department of Mathematics, University of Nebraska.

The methods of E. H. Moore's "General Analysis" are applied to giving a uniform central theory for factorization of different series of expressions.

16. *The Direction of Rotation of Sun-spot Vortices*: GEORGE E. HALE, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

Of the two spots in the typical spot-pair the preceding spot in the low-latitude zone is counter-clockwise north, and clockwise south, of the equator; corresponding to the direction of the rotation of terrestrial tornados. In high latitudes the signs are reversed, giving a result which is likely to prove significant in future studies of the sun.

17. *Some Vortex Experiments Bearing on the Nature of Sun-Spots and Flocculi*: G. E. HALE and G. P. LUCKEY, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

Some of the phenomena of single and multiple sun-spots can be imitated by simple laboratory experiments in which vortices are formed in a water tank with an atmosphere of smoke above the water. Such experiments may assist in accounting for certain char-

acteristic structures and motions of the solar atmosphere. EDWIN BIDWELL WILSON

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE WEATHER ELEMENT IN AMERICAN CLIMATES

CLIMATE may be defined as average weather. Thus Professor R. DeC. Ward is fully justified in opening a discussion of the climates of the United States with a chapter on the Weather Element in American Climates.¹ Winter weather is characteristically changeable. The rapid motions of strong cyclones and anticyclones, with the sun low in the heavens, places the weather primarily under cyclonic control. On the other hand, in summer, when cyclone activity is weak and the sun is high in the sky, the weather under the regular solar control is much the same from day to day. In spring and autumn, the interplay of these two controls is strikingly apparent. A cyclone approaches, giving rise to easterly winds, cloudy weather and rain, with a falling barometer. The solar control vanishes. However, as the storm passes and westerly winds follow, the clouds break away and the diurnal control again dominates.

Weather types depend largely on the origin of the winds which flow towards passing cyclones. Thus, on the eastern coast easterly winds are usually damp and westerly ones dry. In winter, the easterly and southerly winds are warmer than those from the west and north, but in summer the west winds are generally warmer than the east. The same holds true for the central valleys and great plains except that the east winds of summer are often warm. Furthermore, the winter cyclones fail to bring much precipitation to the great plains because of the prevailing cold. On the Pacific coast, west winds are damp and equable; while the land winds from the north and east are dry, and bring the extremes of temperature.

The frequency with which different weather types occur, depends primarily on the paths and frequency of cyclones. In winter, cyclone paths cover practically the whole United

¹ *Annals of the Association of American Geographers*, Vol. IV., 1915, pp. 3-54.

States and cyclones are numerous in the south. With the approach of summer, the cyclone paths move northward with the advance of the sun. Thus, in summer, cyclones generally move along the northern border of the United States. On account of this migration of cyclone paths it is evident that the northerly and easterly types of weather are more frequent in winter than in summer.

Through the masterly treatment of his subject, Professor Ward makes an effective attack on the tendency to describe climates without a thorough consideration of the weather element.

TYPES OF STORMS OF THE UNITED STATES AND THEIR AVERAGE MOVEMENTS²

THIS monograph by E. H. Bowie and R. H. Weightman, of the Weather Bureau, considers the cyclones of the United States from the forecaster's point of view. The 2,597 cyclones shown on the morning and evening weather maps for the years 1892-1912 inclusive are here ably classified and discussed. The data in the voluminous tables are also presented on charts showing for each five degrees square the number, direction and speed of movement of storms classified by regions of origin and by months. The West India cyclones are strikingly portrayed on monthly maps showing their average movements for each 2½ degrees square.

The discussion, although only ten pages long, is well supported by the 21 years of cyclones and the writers' wealth of experience in forecasting. The immediate control of the types of cyclones and their movements is apparently exerted by the subpermanent "high" in the middle latitudes of the North Atlantic and by the center of action known as the "Aleutian low." When the former is well developed, the lows and highs usually move along high latitudes; and stable temperatures above the seasonal average are experienced over the eastern half of the United States. When the Aleutian low is well-developed and south of its normal position, cyclones enter

and cross the United States in low latitudes and are accompanied by stormy weather and great alternations in temperatures. Apparently, the cyclones entering the country from the west and north are offshoots from this subpermanent low.

The authors have indicated how the movements of cyclones are apparently closely connected with the temperature, wind, and rain conditions in the vicinity of the cyclonic center. Also the general pressure distribution and pressure changes influence cyclones. These connections are of direct value not only to the forecaster but also to the meteorologist studying the dynamics of cyclones.

METHODS OF CLIMATIC PRESENTATION

Equipluves or Isomers.—In the *Scottish Geographical Magazine*, July, October and November, 1914, and February, 1915,³ Mr. B. C. Wallis has presented the monthly rainfall of Africa, Australia and the eastern United States by means of equipluves (lines which show the rainfall in proportion of the annual). The maps of Africa and Australia afford excellent examples of the value of this method. In spite of the almost total lack of rainfall in parts, the maps show the monthly importance of the rain there as elsewhere. Thus the swing of the tropical and subtropical rain belts with the sun is shown more clearly than on maps of actual rainfall.

In the eastern United States the rainfall intensity as well as the actual amount of precipitation depends on three factors: (1) the "swing of the sun," which has its most marked effect farthest from the sea; and is characterized by summer rains and winter dryness; (2) the proximity of the ocean, which, by causing heavy rainfall, makes to some extent the effect of insolation; and (3) local temperature conditions which have their most marked effect in causing variations in the months of maximum and minimum intensity of rainfall.

Dr. H. R. Mill and Mr. Carle Salter, of the British Rainfall Organization, have applied much the same method to the study of the

² *Mo. Weather Rev. Supplement*, No. 1, 37 pp.; 114 charts, November, 1914.

³ See also *Mo. Weather Rev.*, January, 1915, pp. 11-24.

rainfall of Great Britain.⁴ In winter (December, January and February) the highest rainfall percentages are found in the southwest portions of the British Isles; for there, the comparatively warm, moist ocean winds are cooled on reaching land. In spring, with the rise of land temperature relative to that of the ocean, there is generally deficient rainfall, the highest percentages occurring in the east. For the summer quarter, the eastern percentages rise to more than 30 locally while those in the west remain below 25. In autumn, the rainfall exceeds 30 per cent. of the annual total on the coasts of England and Scotland while the maximum is less intense in Ireland. Such maps, free from the confusing details of the actual rainfall distribution, are well fitted for exhibiting the seasonal rainfall variations.

Thermal Anomalies.—Of two methods of indicating thermal anomalies, the first, and that most generally used, is to construct isonomalous lines which show the difference between the temperature of a place and the mean for its latitude—no account being taken of the relative amounts of land and water. In the *Scottish Geographical Magazine*, July, 1914 (pp. 356-363), Mr. B. C. Wallis has presented apparently the first monthly maps of thermal anomalies of the world. The negative anomalies of the continents in winter become positive in summer, while the positive anomalies of the oceans in winter change to negative. As the northern hemisphere summer approaches, there is a weakening of anomalies throughout the world, a feature due to the unequal distribution of land in the two hemispheres.

The other method of computing thermal anomalies is based on the difference between the temperature of a place and the temperature its latitude would have if the hemisphere were wholly land (if the place is on land) or wholly water (if the place is marine in location). These anomalies Mr. J. Liznar calls "true thermal anomalies."⁵ Thus such figures

⁴ "Isomeric Rainfall Maps of the British Isles," *Quart. Jour. Roy. Meteorological Soc.*, January, 1915, pp. 1-44.

⁵ *Meteorological Zeitschr.*, February, 1915, pp. 69-73.

give a true measure of the degree of land or ocean influence, but do not necessarily show the difference in temperature between one place and another in the same latitude. The accompanying table indicates the sea level temperature of the different latitudes of land and water hemispheres:

Lat.....	0	10	20	30	40
Land.....	33.7° C.	32.6	29.3	23.8	15.8
Water.....	23.9	23.2	21.0	17.3	12.3
Difference.....	9.8	9.4	8.3	6.5	3.5
Lat.....	50	60	70	80	90
Land.....	5.4	-7.5	-19.7	-36.1	-28.3
Water.....	5.6	-2.1	-9.0	-12.2	-13.5
Difference.....	-0.2	-5.4	-10.7	-13.9	-14.8

Land in any latitude is generally colder than if the earth were entirely land. The exceptions are Europe, North Asia south to 60° and western North America. At 70° N., Greenland has a great positive anomaly of 17.3° C. and the northwest coast of Norway one of 22.1° C. The greatest negative anomalies are on land near the equator. The oceans are mostly too warm for the latitude but the anomalies are smaller than those on land. Areas of negative anomalies are the south Atlantic and south Indian oceans, and the west coasts of North and South America. The anomalies show clearly the transportation of warmth by air and water.

Climatic Profiles.—So many elements are now shown on separate climatic maps that it is difficult to get general impressions of climates. Dr. K. Mahler⁶ has proposed the use of climatic profiles as a remedy. To illustrate he has chosen three profiles in India. Curves of mean temperature, air pressure, precipitation, cloudiness, relative humidity and vapor pressure are placed one above the other over a profile of land relief. In such a single picture the fluctuations of the climatic means are easy to determine and compare. Dr. Mahler suggests (as did Henry Gannett in 1902, *Monthly Weather Review*, April, 1902) the establishment of lines of observatories

⁶ *Verein f. Erdkunde*, Dresden, Mitteilungen bd. 2, pp. 745-48; 3 pl., 1913.

along characteristic profiles. In this way, at slight expense we might be able to gain a more complete understanding of the climatology of a region.

VON HANN'S LEHRBUCH

METEOROLOGISTS in this country welcome the completion of Dr. Julius von Hann's "Lehrbuch der Meteorologie," third edition.⁷ This monumental bibliographical text-book takes its place at the head of works on meteorology. The full title is: "Lehrbuch der Meteorologie" von Dr. Julius von Hann, Professor an der Universität Wien. Dritte unter Mitwirkung von Professor Dr. Suring (Potsdam) umgearbeitete Auflage. Leipzig, 1915, Chr. Herm. Tauchnitz. Pp. xiv + 847, 28 pl., 4 tables, 108 figs. in text. Price 36 marks.

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SPECIAL ARTICLES

A CULTURE DIFFERENCE BETWEEN THE PIMA AND PAPAGO INDIANS

IN an expedition for the anthropological department of the American Museum of Natural History to the Southwest in the winter of 1901-1911, a number of new facts were obtained during a comprehensive study of the textile arts in two dozen villages of the linguistically related Papago and Pima tribes, which soon will be fully treated in a forthcoming publication of the American Museum.

All who had previously gone among these tribes reported that the coiled basketry bearing the conventional black designs is the same in the two tribes. The existence of a marked difference had eluded former students, but was disclosed by an intensive study of their textile arts. The identity of Pima and Papago basketry was a natural inference, as there is constant trading between them, and in many of the Papago huts are to be found, along with their own coiled baskets, those of the Pima, obtained by exchange for other articles made exclusively by the Papago.

⁷ Review by Professor R. deC. Ward, SCIENCE, November 27, 1904, pp. 785-86.

The discovery of a distinct Papago coiled ware is a vital point, since it gives an individuality, a distinct place, to Papago coiled basketry, setting it apart from coiled ware of other tribes. The distinguishing features when compared with Pima baskets, appear in shape, in substantialness of build, and in design: for the base of these old bowls and trays is flat and broad, in contrast to the narrow base of the Pima; the walls are thick, firm, and in strong spherical curves, in opposition to the thin, pliable walls in more subtle, delicate curves of the Pima; the designs reversed and on a horizontal and vertical plan, contrary to the active, spiral arrangement of the Pima. I learn from Dr. Fewkes, who has made an extensive archeological study of the region, that this cultural differentiation may be regarded as an important discovery in connection with the problem of correlating archeological data from the prehistoric people of the same area.

The expedition was fortunate in securing some very interesting material, among which was an old Pima sleeping mat, which long ago ceased to be made for lack of material, since the white man has cut off the water supply from the headwaters of the few rivers along which the rush, *Phragmitis communis*, used to grow. There was also obtained a Papago ceremonial food bowl, used only when the medicineman goes upon religious pilgrimages for the sacred salt found below the Mexican boundary. On these journeys his food consists of pinole, eaten from this water-tight basket-bowl, out of which he also drinks. Another even greater acquisition was six Papago medicine baskets enclosing the magic accessories for curing the sick and also for controlling the weather: two of these were rain baskets, one contained medicine for healing rheumatism and the diseases of old age, another a remedy for fever, still another for keeping off the Apache, whom they very much feared, and the sixth a white powder given to infants and their parents to secure protection during life from evil spirits.

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